Study of Thermomechanical Properties of Lanthanum Zirconate Based Thermal Barrier Coatings

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Abstract

$La_2Zr_2O_7$ is a promising thermal barrier coating material due to its low thermal conductivity and superior high temperature stability. In this work, $La_2Zr_2O_7$ and conventional 8 wt% yttria stabilized zirconia (8YSZ) coatings were deposited using plasma spray technique. Both single-layer $La_2Zr_2O_7$ and double-layer 8YSZ/$La_2Zr_2O_7$ coating architectures were designed. Thermal conductivity and coefficients of thermal expansion (CTE) of the coatings were measured. The measured average thermal conductivity of $La_2Zr_2O_7$ was about 25% lower than that of porous 8YSZ. The CTE values of $La_2Zr_2O_7$ were about 10% lower than that of 8YSZ. Thermal cycling and thermal shock tests were used to evaluate coatings' thermomechanical properties. All $La_2Zr_2O_7$ coats were delaminated in the furnace cycle test in less than 20 cycles. This is because residual thermal stresses accumulated during thermal cycling. In the jet engine thermal shock (JETS) tests, the single-layer $La_2Zr_2O_7$ and double-layer dense 8YSZ/$La_2Zr_2O_7$ coatings were fully delaminated. In contrast, the double-layer porous 8YSZ/$La_2Zr_2O_7$ coating sample only partially delaminated on the edge. This is because the porous 8YSZ layer provides strain compliance. The findings will help to propose efficient thermal barrier coating systems.